A PRELIMINARY STUDY OF SOME MODERN MICROMETERS

By MARSHALL D. EWELL.

(*Read April 19, 1907.*)

With the advent of the International Bureau of Weights and Measures and our own National Bureau of Standards, each of which has done and is doing a great work in the extension of a uniform and correct system of standards throughout the world, it was to be expected that this uniformity and precision would be exemplified in the stage micrometers manufactured and for sale by makers of scientific instruments in this and other countries. With a view to determining how far this expectation has been realized the writer has collected as many stage micrometers as he conveniently could by purchase from dealers or through the courtesy of friends, and has measured from five to ten spaces on each with great care and herewith presents in part the results of such measurements. The instruments used were an excellent stand made especially for micrometry by the late W. H. Bulloch, a very stable stand made by the Spencer Lens Co., filar micrometers by Zeiss, The Spencer Lens Co., Bausch and Lomb, Zentmayer and others, and a Bausch and Lomb opaque illuminating one-inch objective, a Zeiss A A. and a Leitz No. 3 objective. From five to ten readings were taken at each end of the space measured and the mean taken. The errors in total length of the several spaces measured have not yet been determined, though the observations have been made; and the results here given are the relative errors only or the differences between each designated space and the mean of all the measured spaces. These scales were all, except where otherwise designated, ruled on glass, and in many instances the lines have deteriorated to a considerable extent, though not so as to invalidate the measurements. A few were photographs and one or two had very coarse lines, so coarse as to render them unsuitable for any but low powers.

A + sign indicates that the measured space is too short and a — sign that the space is too long. The unit of measurement is the micron $= \frac{1}{1000}$ mm.

No. I. Glass Micrometer by Bausch and Lomb—Metric scale.

Space Measured		Relative Correction.
First	$\frac{1}{10}$ mm	— 1.0 micron.
Second	$\frac{1}{10}$ mm	— 1.8 micron.
Third	$\frac{1}{10}$ mm	+ 1.0 micron.
Fourth	$\frac{1}{10}$ mm	+ 1.0 micron.
Fifth	$\frac{1}{10}$ mm	+ 0.8 micron.

No. II. Photograph by Möller.

Space.		Relative Correction.
First	$\frac{1}{10}$ mm	0.0 micron.
Second	$\frac{1}{10}$ mm	— 0.1 micron.
Third	$\frac{1}{10}$ mm	0.0 micron.
Fourth	$\frac{1}{10}$ mm	+ 0.2 micron.
Fifth	$\frac{1}{10}$ mm	— 0.1 micron.

No. III. Glass Scale ruled on the Engine owned by Cornell University.

Space.		Relative Correction.
First	$\frac{1}{10}$ mm	+ 0.2 micron.
Second	$\frac{1}{10}$ mm	+ 0.3 micron.
Third	$\frac{1}{10}$ mm	0.0 micron.
Fourth	$\frac{1}{10}$ mm	0.0 micron.
Fifth	$\frac{1}{10}$ mm	— 0.4 micron.

No. IV. Glass Scale by Zentmayer.

Space.		Relative Correction
First	$\frac{1}{10}$ mm	— 0.4 micron.
Second	$\frac{1}{10}$ mm	— 0.5 micron.
Third	$\frac{1}{10}$ mm	0.0 micron.
Fourth	$\frac{1}{10}$ mm	+ 0.5 micron.
Fifth	$\frac{1}{10}$ mm	+ 0.4 micron.

No. V. Glass Scale by E. Leitz.

Space.		Relative Correction.
First	$\frac{1}{10}$ mm	+ 0.1 micron.
Second	$\frac{1}{10}$ mm	+ 0.1 micron.
Third	$\frac{1}{10}$ mm	+ 0.1 micron.
Fourth	$\frac{1}{10}$ mm	— 0.1 micron.
Fifth	$\frac{1}{10}$ mm	— 0.2 micron.

No. VI. Glass Scale by Zeiss.

Space.		Relative Correction.
First	$\frac{1}{10}$ mm	— 0.2 micron.
Second	$\frac{1}{10}$ mm	+ 0.2 micron.
Third	$\frac{1}{10}$ mm	+ 0.7 micron.
Fourth	$\frac{1}{10}$ mm	— 0.3 micron.
Fifth	$\frac{1}{10}$ mm	— 0.4 micron.

No. VII. Glass Scale by Powell and Leeland.

Space.		Relative Correction.
First	$\frac{1}{10}$ mm	+ 0.7 micron.
Second	$\frac{1}{10}$ mm	— 1.0 micron.
Third	$\frac{1}{10}$ mm	+ 0.9 micron.
Fourth	$\frac{1}{10}$ mm	— 0.5 micron.
Fifth	$\frac{1}{10}$ mm	— 0.1 micron.

No. VIII. Glass Scale by Watson.

Space.		Relative Correction.
First	$\frac{1}{10}$ mm	+ 0.5 micron.
Second	$\frac{1}{10}$ mm	— 0.5 micron.
Third	$\frac{1}{10}$ mm	+ 2.9 micron.
Fourth	$\frac{1}{10}$ mm	— 1.7 micron.
Fifth	$\frac{1}{10}$ mm	— 1.2 micron.

No. IX. English Scale on Speculum Metal by the late Professor W. A. Rogers.

Space		Relative Correction.
First	$\frac{1}{100}$ inch	+ 0.4 micron.
Second	$\frac{1}{100}$ inch	— 0.6 micron.
Third	$\frac{1}{100}$ inch	— 0.3 micron.
Fourth	$\frac{1}{100}$ inch	+ 0.7 micron.
Fifth	$\frac{1}{100}$ inch	+ 0.4 micron.
Sixth	$\frac{1}{100}$ inch	— 0.8 micron.
Seventh	$\frac{1}{100}$ inch	+ 0.2 micron.
Eighth	$\frac{1}{100}$ inch	— 0.3 micron.
Ninth	$\frac{1}{100}$ inch	+ 0.1 micron.
Tenth	$\frac{1}{100}$ inch	+ 0.1 micron.

No. X. Scale on Platinum Iridium, known as "Centimeter A" the Standard of the American Microscopical Society.

Space.		Correction (total).
First	$\frac{1}{10}$ mm	+ 0.20 micron.
Second	$\frac{1}{10}$ mm	+ 0.13 micron.
Third	$\frac{1}{10}$ mm	+ 0.84 micron.
Fourth	$\frac{1}{10}$ mm	— 0.60 micron.
Fifth	$\frac{1}{10}$ mm	— 0.44 micron.
Sixth	$\frac{1}{10}$ mm	+ 0.22 micron.
Seventh	$\frac{1}{10}$ mm	— 0.14 micron.
Eighth	$\frac{1}{10}$ mm	+ 0.21 micron.
Ninth	$\frac{1}{10}$ mm	— 0.02 micron.
Tenth	$\frac{1}{10}$ mm	+ 0.18 micron.

The last two scales (IX and X) were ruled from 20 to 25 years ago and are included in this list simply for the purpose of comparison with more recent productions.

The results above given need no comment and show that no advance in precision has been made in the last twenty-five years; indeed the results do not seem to equal those of the former period.

CHICAGO, April 15, 1907.